Fig. 1

A: write data

B: high order bit

C: low order bit

D: read data

3: control portion

4: bit switching portion

5: bit switching portion

6: write address counter

7: read address counter

8: address conversion portion

9: address conversion portion

10: address conversion portion

11: address conversion portion

12: address switching portion

13: address switching portion

14: address switching portion

15: address switching portion

16: read data switching portion

Fig. 4

A: write data

B: memory 1 write address

data

C: memory 2

Fig. 5

A: read data

B: memory 1 read address

data

C: memory 2

Fig. 6

A: 1st, 3rd, 5th, 7th rows: unchanged

B: 2nt, 4th, 6th, 8th rows: shifted one place

Fig. 7

A: 1st, 5th rows: unchanged

B: 2nt, 6th rows: shifted one place

C: 3rd, 7th rows: shifted two places

D: 4th, 8th rows: shifted three places

Fig. 8

A: 1st row: unchanged

B: 2nt row: shifted one place

C: 3rd row: shifted two places

D: 4th row: shifted three places

E: 5th row: shifted four places

F: 6th row: shifted five places

G: 7th row: shifted six places

H: 8th row: shifted seven places

Fig. 10

A: write data

B: memory 1 write address

data

C: memory 2 write address

data

D: read data

E: memory 1 read address

data

F: memory 2 read address

data

Fig. 11

A: write data

B: memory 1 write address

data

C: memory 2 write address

data

D: read data

E: memory 1 read address

data

F: memory 2 read address

Data

Fig. 13

201: bank memory

202: address generating portion

203: data counter portion

205: selector

206: Huffman encoding portion

Fig. 14

A: four cycles

B: contents of FIFO 204a

C: run length

D: valid coefficient

E: contents of FIFO 204b

F: five cycles

Fig. 15

211: Huffman decoding portion

212: selector

214: data counter portion

215: bank memory

216: address generating portion

Fig. 16

301: head search process portion

302: frequency-of-occurrence generating portion

303: memory

305: selector

A: compressed image data

B: Huffman code

C: decoded data

R1: register

C1: comparator

Ri: register

Ci: comparator

Fig. 17

302: frequency-of-occurrence generating portion

303: memory

321: constant storing portion

322: minimum code storing portion

323: code length detecting portion

324: selector

325: adder

A: Huffman code

B: frequency of occurrence

C: decoded data

D: code length

Fig. 18

100: DCT process portion

200: quantizing portion

206: Huffman encoding portion

400: quantization table

500: encoding table

800: reverse DCT process portion

700: dequantization portion

211: Huffman decoding portion

A: original image data

B: compressed image data

C: reproduced image data

Fig. 19

A: formation of blocks of image data

B: block

Fig. 20

A: 8 X 8 pixel block

B: DCT process

C: frequency

Fig. 21

110: one-dimensional DCT circuit

120: inversion memory

130: one-dimensional DCT circuit

Fig. 22

A: frequency in horizontal direction

B: frequency in vertical direction

C: low

D high

Fig. 23

A: zigzag scan

B: DCT coefficient

Fig. 24

A: raster scan (direction of rows)

B: raster scan (direction of columns)

Fig. 25

A: raster scan (direction of rows)

B: zigzag (direction of columns)

Fig. 26

221: bank memory

222: Huffman encoding circuit

Fig. 27

Eight cycles

Fig. 28

311: head search process portion

312: memory

(2^k words)

A: compressed image data

C: decoded data

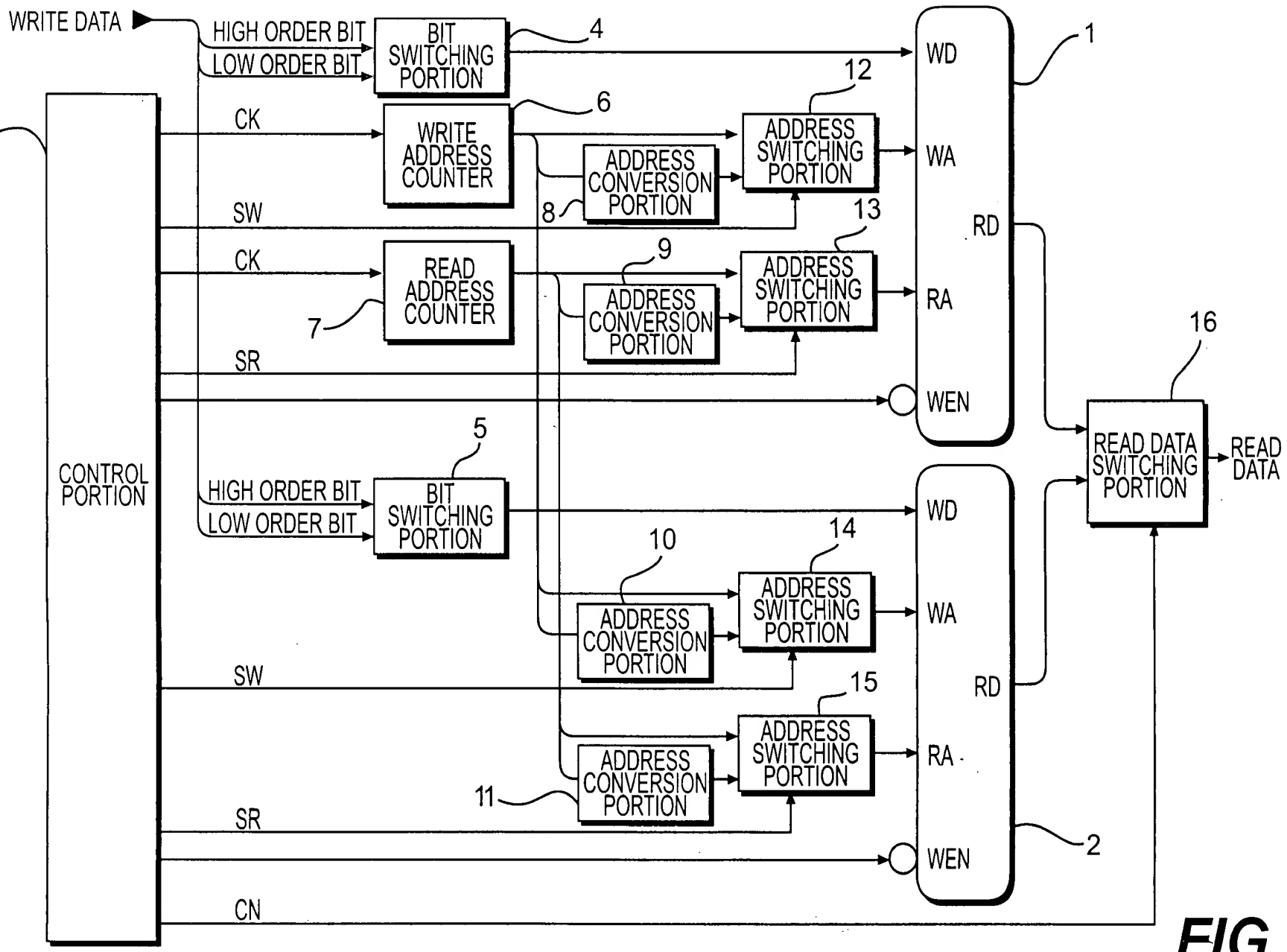

FIG. 1

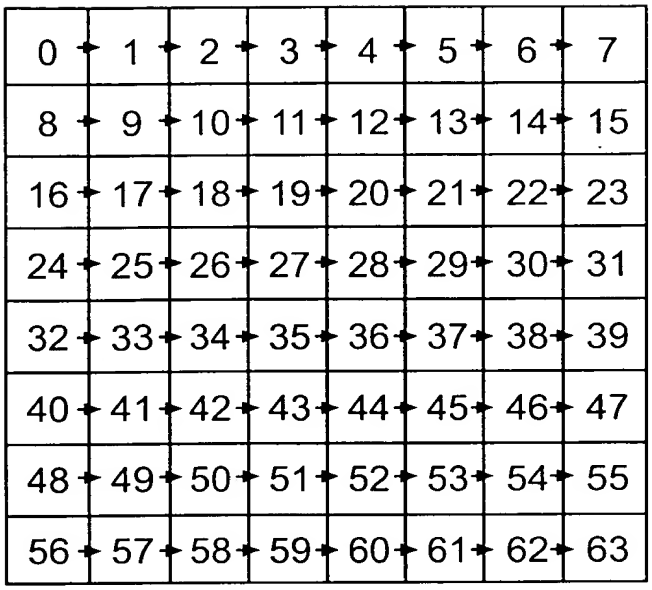

FIG. 2(a)

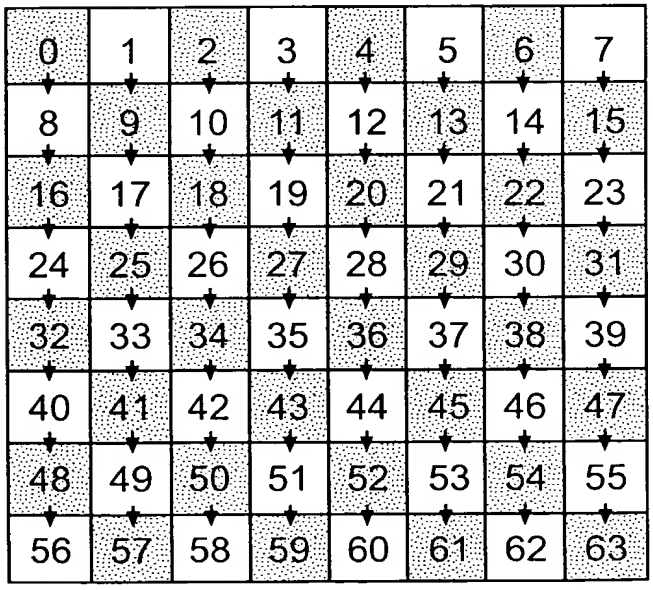

FIG. 2(b)

0	1	2	3	4	5	6	7
9	8	11	10	13	12	15	14
16	17	18	19	20	21	22	23
25	24	27	26	29	28	31	30
32	33	34	35	36	37	38	39
41	40	43	42	45	44	47	46
48	49	50	51	52	53	54	55
57	56	59	58	61	60	63	62

FIG. 2(c)

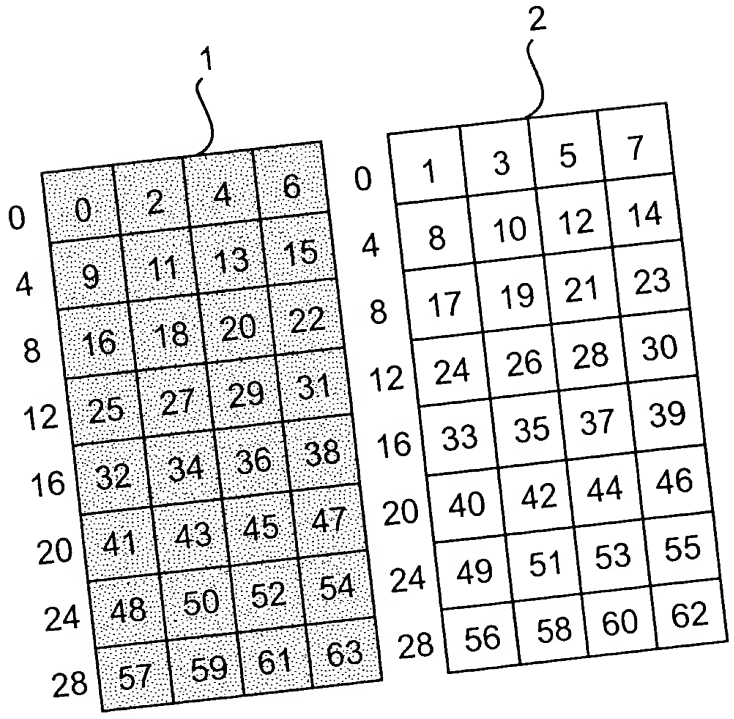

FIG. 2(d)

0	8	16	24	32	40	48	56
1	9	17	25	33	41	49	57
2	10	18	26	34	42	50	58
3	11	19	27	35	43	51	59
4	12	20	28	36	44	52	60
5	13	21	29	37	45	53	61
6	14	22	30	38	46	54	62
7	15	23	31	39	47	55	63

FIG. 3(a)

0	8	16	24	32	40	48	56
1	9	17	25	33	41	49	57
2	10	18	26	34	42	50	58
3	11	19	27	35	43	51	59
4	12	20	28	36	44	52	60
5	13	21	29	37	45	53	61
6	14	22	30	38	46	54	62
7	15	23	31	39	47	55	63

FIG. 3(b)

0	8	16	24	32	40	48	56
9	1	25	17	41	33	57	49
2	10	18	26	34	42	50	58
11	3	27	19	43	35	59	51
4	12	20	28	36	44	52	60
13	5	29	21	45	37	61	53
6	14	22	30	38	46	54	62
15	7	31	23	47	39	63	55

FIG. 3(c)

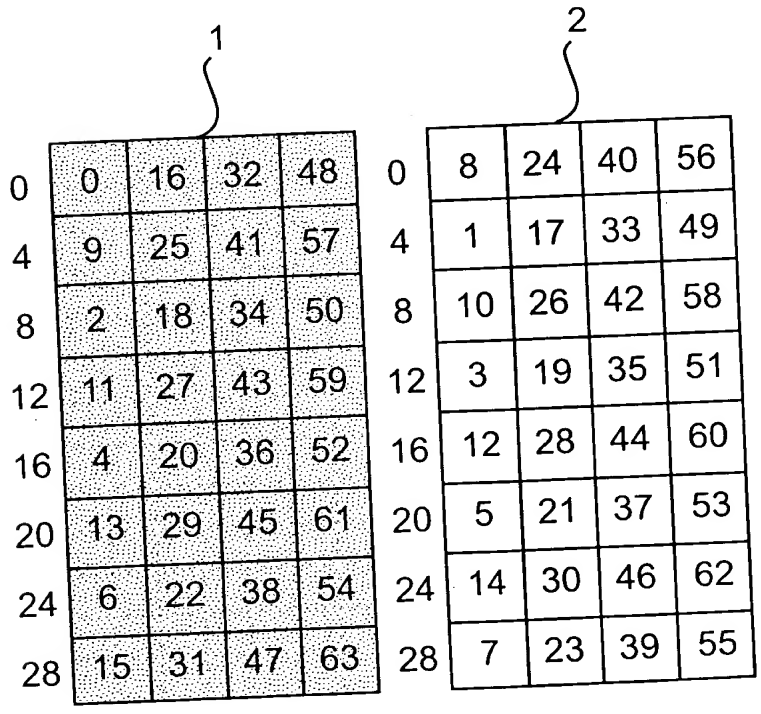

FIG. 3(d)

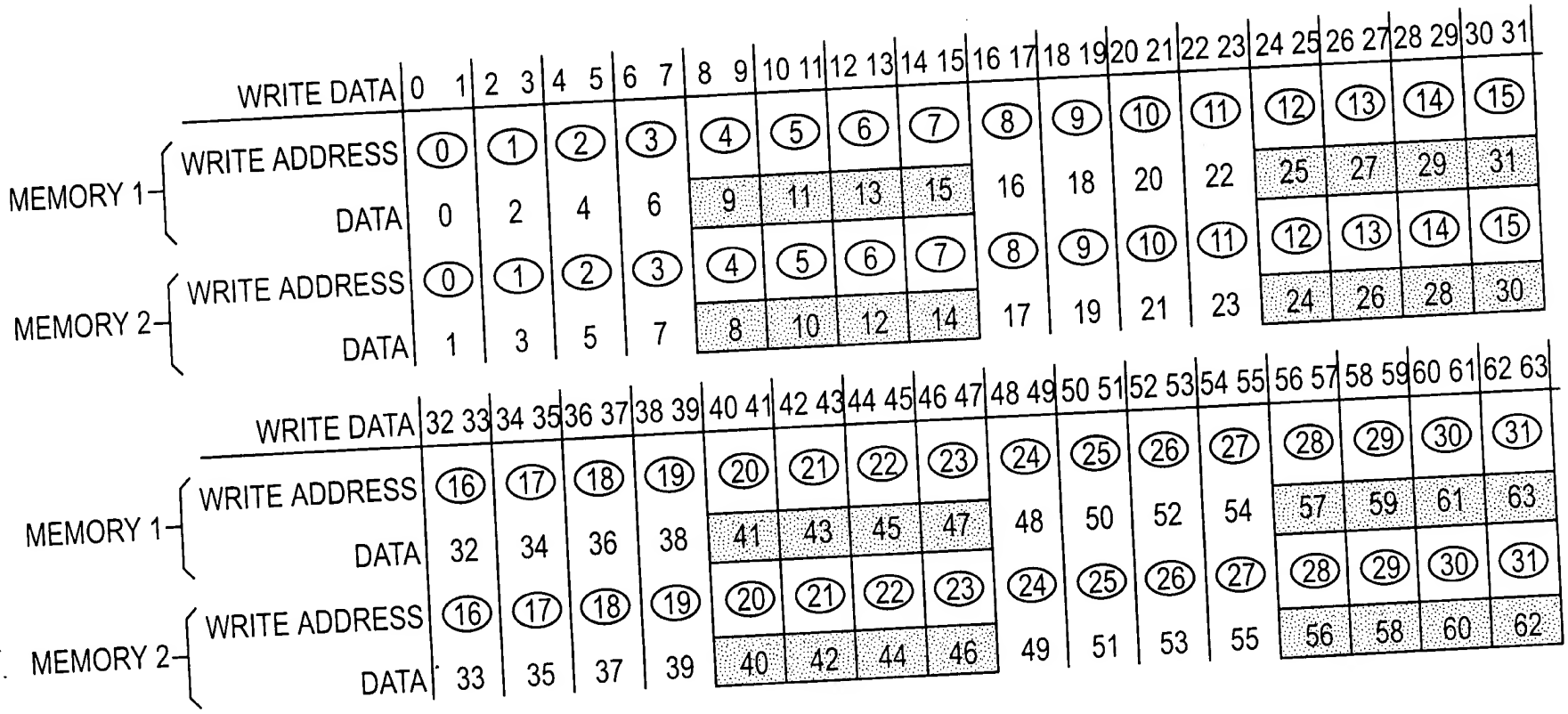

FIG. 4

	READ DATA	0 8	16 24	32 40	48 56	1 9	17 25	33 41	49 57	2 10	18 26	34 42	50 58	3 11	19 27	35 43	51 59								
MEMORY 1	READ ADDRESS	(0)	(8)	(16)	(24)	(4)	(12)	(20)	(28)	(1)	(9)	(17)	(25)	(5)	(13)	(21)	(29)								
	DATA	0	16	32	48	9	25	41	57	2	18	34	50	11	27	43	59								
MEMORY 2	READ ADDRESS	(4)	(12)	(20)	(28)	(0)	(8)	(16)	(24)	(5)	(13)	(21)	(29)	(1)	(9)	(17)	(25)								
	DATA	8	24	40	56	1	17	33	49	10	26	42	58	3	19	35	51								

	READ DATA	4 12	20 28	36 44	52 60	5 13	21 29	37 45	53 61	6 14	22 30	38 46	54 62	7 15	23 31	39 47	55 63								
MEMORY 1	READ ADDRESS	(2)	(10)	(18)	(26)	(6)	(14)	(22)	(30)	(3)	(11)	(19)	(27)	(7)	(15)	(23)	(31)								
	DATA	4	20	36	52	13	29	45	61	6	22	38	54	15	31	47	63								
MEMORY 2	READ ADDRESS	(6)	(14)	(22)	(30)	(2)	(10)	(18)	(26)	(7)	(15)	(23)	(31)	(3)	(11)	(19)	(27)								
	DATA	12	28	44	60	5	21	37	53	14	30	46	62	7	23	39	55								

FIG. 5

0	1	2	3	4	5	6	7
8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23
24	25	26	27	28	29	30	31
32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47
48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63

1ST, 3RD, 5TH, 7TH ROWS: UNCHANGED

2ND, 4TH, 6TH, 8TH ROWS: SHIFTED ONE PLACE

FIG. 6(a)

B0	B1	B0	B1	B0	B1	B0	B1
0	1	2	3	4	5	6	7
9	8	11	10	13	12	15	14
16	17	18	19	20	21	22	23
25	24	27	26	29	28	31	30
32	33	34	35	36	37	38	39
41	40	43	42	45	44	47	46
48	49	50	51	52	53	54	55
57	56	59	58	61	60	63	62

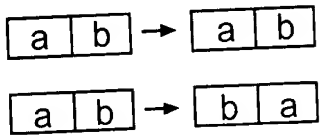

FIG. 6(b)

B0	B1	B0	B1	B0	B1	B0	B1
0	8	16	24	32	40	48	56
9	1	25	17	41	33	57	49
2	10	18	26	34	42	50	58
11	3	27	19	43	35	59	51
4	12	20	28	36	44	52	60
13	5	29	21	45	37	61	53
6	14	22	30	38	46	54	62
15	7	31	23	47	39	63	55

FIG. 6(c)

0	1	2	3	4	5	6	7
8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23
24	25	26	27	28	29	30	31
32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47
48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63

1ST, 5TH ROWS: UNCHANGED

2ND, 6TH ROWS: SHIFTED ONE PLACE

3RD, 7TH ROWS: SHIFTED TWO PLACES

4TH, 8TH ROWS: SHIFTED THREE PLACES

FIG. 7(a)

B0	B1	B2	B3	B0	B1	B2	B3
0	1	2	3	4	5	6	7
11	8	9	10	15	12	13	14
18	19	16	17	22	23	20	21
25	26	27	24	29	30	31	28
32	33	34	35	36	37	38	39
43	40	41	42	47	44	45	46
50	51	48	49	54	55	52	53
57	58	59	56	61	62	63	60

a	b	c	d	→	a	b	c	d
a	b	c	d	→	d	a	b	c
a	b	c	d	→	c	d	a	b
a	b	c	d	→	b	c	d	a

FIG. 7(b)

B0	B1	B2	B3	B0	B1	B2	B3
0	8	16	24	32	40	48	56
25	1	9	17	57	33	41	49
18	26	2	10	50	58	34	42
11	19	27	3	43	51	59	35
4	12	20	28	36	44	52	60
29	5	13	21	61	37	45	53
22	30	6	14	54	62	38	46
15	23	31	7	47	55	63	39

FIG. 7(c)

0	1	2	3	4	5	6	7
8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23
24	25	26	27	28	29	30	31
32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47
48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63

1ST ROW: UNCHANGED
2ND ROW: SHIFTED ONE PLACE
3RD ROW: SHIFTED TWO PLACES
4TH ROW: SHIFTED THREE PLACES
5TH ROW: SHIFTED FOUR PLACES
6TH ROW: SHIFTED FIVE PLACES
7TH ROW: SHIFTED SIX PLACES
8TH ROW: SHIFTED SEVEN PLACES

FIG. 8(a)

B0	B1	B2	B3	B4	B5	B6	B7
0	1	2	3	4	5	6	7
15	8	9	10	11	12	13	14
22	23	16	17	18	19	20	21
29	30	31	24	25	26	27	28
35	37	38	39	32	33	34	35
43	44	45	46	47	40	41	42
50	51	52	53	54	55	48	49
57	58	59	60	61	62	63	56

a	b	c	d	e	f	g	h
a	b	c	d	e	f	g	h
a	b	c	d	e	f	g	h
a	b	c	d	e	f	g	h
a	b	c	d	e	f	g	h
a	b	c	d	e	f	g	h
a	b	c	d	e	f	g	h
a	b	c	d	e	f	g	h

FIG. 8(b)

B0	B1	B2	B3	B4	B5	B6	B7
0	8	16	24	32	40	48	56
57	1	9	17	25	33	41	49
50	58	2	10	18	26	34	42
43	51	59	3	11	19	27	35
36	44	52	60	4	12	20	28
29	37	45	53	61	5	13	21
22	30	38	46	54	62	6	14
15	23	31	39	47	55	63	7

a	b	c	d	e	f	g	h
h	a	b	c	d	e	f	g
g	h	a	b	c	d	e	f
f	g	h	a	b	c	d	e
e	f	g	h	a	b	c	d
d	e	f	g	h	a	b	c
c	d	e	f	g	h	a	b
b	c	d	e	f	g	h	a

FIG. 8(c)

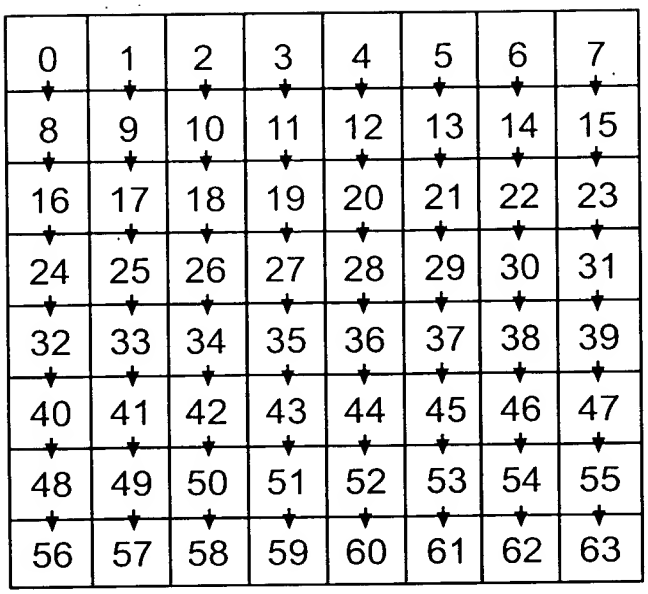

FIG. 9(a)

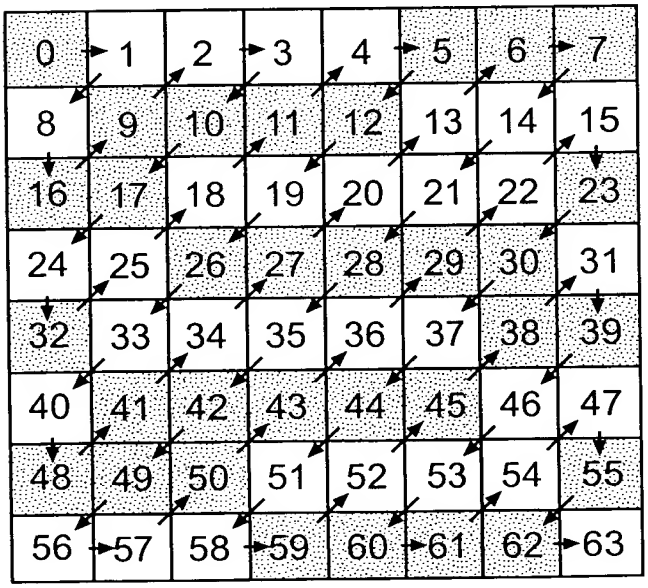

FIG. 9(b)

0	1	2	3	4	5	6	7
8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23
24	25	26	27	28	29	30	31
32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47
48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63

FIG. 9(c)

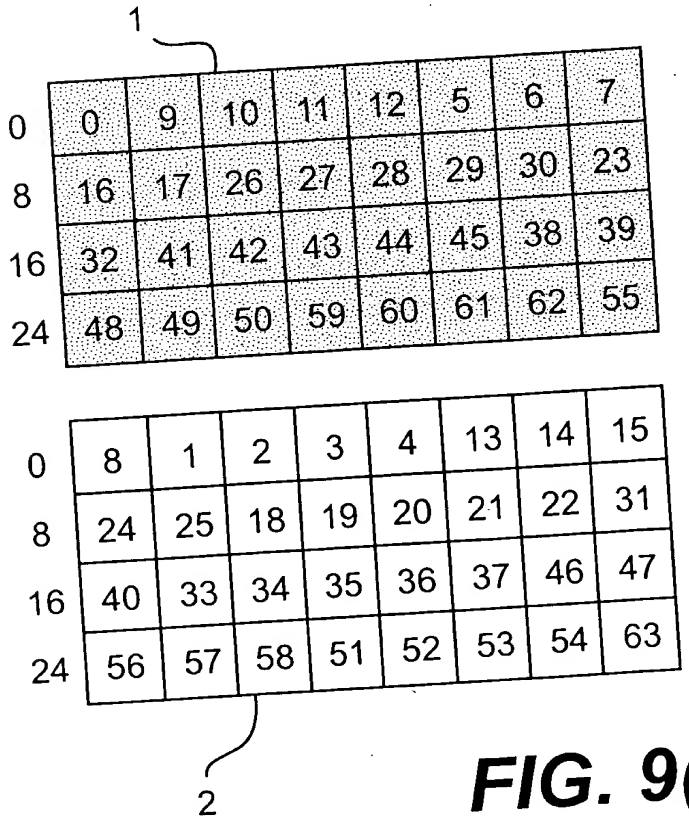

FIG. 9(d)

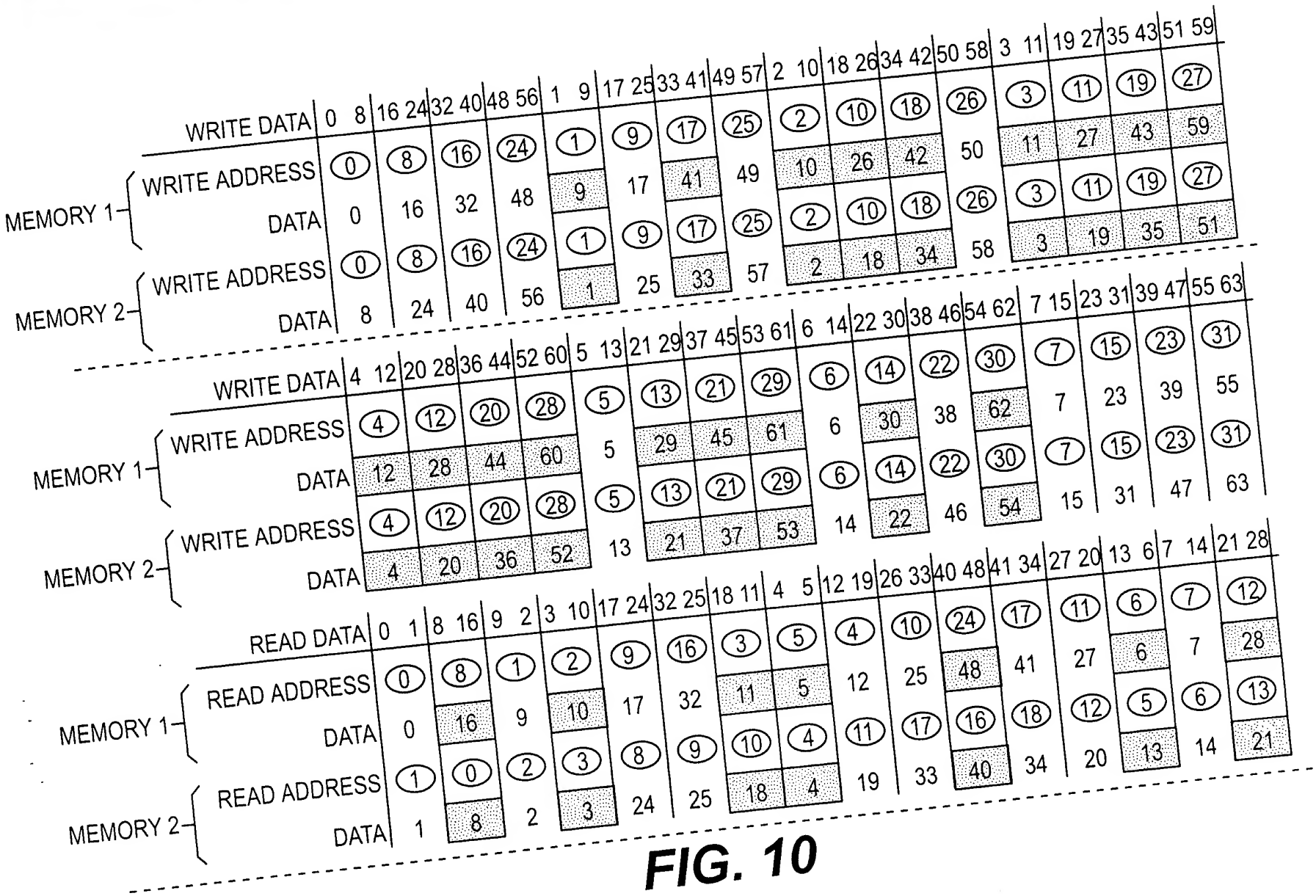
WRITE DATA 0 8 16 24 32 40 48 56 1 9 17 25 33 41 49 57 2 10 18 26 34 42 50 58 3 11 19 27 35 43 51 59
MEMORY 1
WRITE ADDRESS 0 8 16 24 1 9 17 25 33 41 49 57 2 10 18 26 34 42 50 58 3 11 19 27 35 43 51 59
DATA 0 16 32 48 9 17 41 49 10 26 42 50 11 27 43 59
MEMORY 2
WRITE ADDRESS 0 8 16 24 1 9 17 25 33 41 49 57 2 10 18 26 34 42 50 58 3 11 19 27 35 43 51 59
DATA 8 24 40 56 1 25 33 57 2 18 34 58 3 19 35 51
WRITE DATA 4 12 20 28 36 44 52 60 5 13 21 29 37 45 53 61 6 14 22 30 38 46 54 62 7 15 23 31 39 47 55 63
MEMORY 1
WRITE ADDRESS 4 12 20 28 5 13 21 29 37 45 53 61 6 14 22 30 38 46 54 62 7 15 23 31 39 47 55 63
DATA 12 28 44 60 5 29 45 61 6 30 38 62 7 23 39 55
MEMORY 2
WRITE ADDRESS 4 12 20 28 5 13 21 29 37 45 53 61 6 14 22 30 38 46 54 62 7 15 23 31 39 47 55 63
DATA 4 20 36 52 13 21 37 53 14 22 46 54 15 31 47 63
READ DATA 0 1 8 16 9 2 3 10 17 24 32 25 18 11 4 5 12 19 26 33 40 48 41 34 27 20 13 6 7 14 21 28
MEMORY 1
READ ADDRESS 0 8 1 2 9 16 3 5 4 10 24 17 11 6 7 12
DATA 0 16 9 10 17 32 11 5 12 25 48 41 27 6 7 28
MEMORY 2
READ ADDRESS 1 0 2 3 8 9 10 4 11 17 16 18 12 5 6 13
DATA 1 8 2 3 24 25 18 4 19 33 40 34 20 13 14 21

FIG. 10

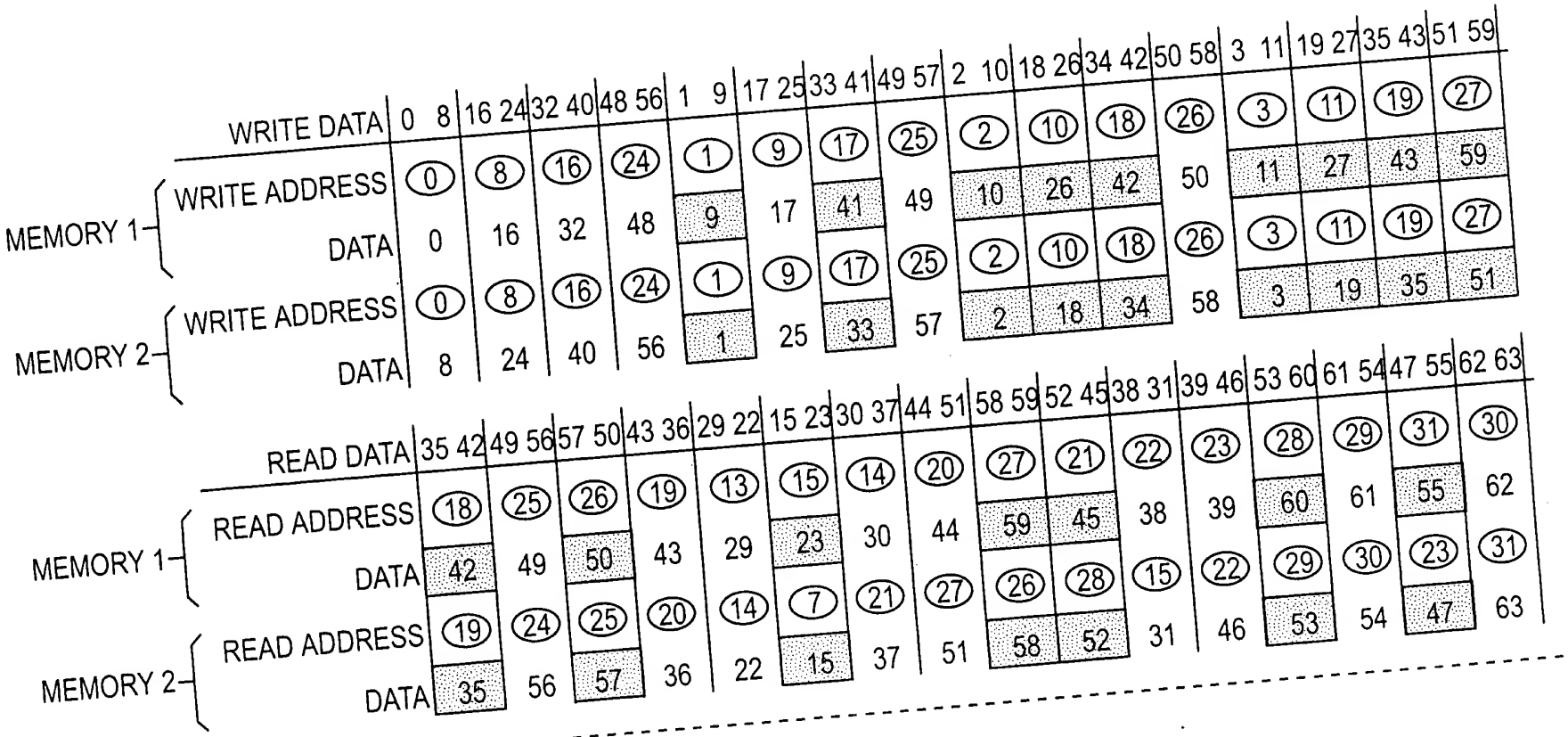

FIG. 11

0	1	2	3	4	5	6	7
8	9	10	11	12	13	14	15
16	17	17	18	19	20	21	23
24	25	26	27	28	29	30	31
32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47
48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63

FIG. 12(a)

B0	0	25	2	19	4	13	14	15
B1	8	9	50	59	12	5	6	7
B2	16	17	10	11	20	21	30	23
B3	24	1	18	3	28	37	22	47
B0	40	57	58	35	44	53	38	55
B1	32	41	42	51	60	29	46	63
B2	48	49	26	43	52	61	62	31
B3	56	33	34	27	36	45	54	39

FIG. 12(b)

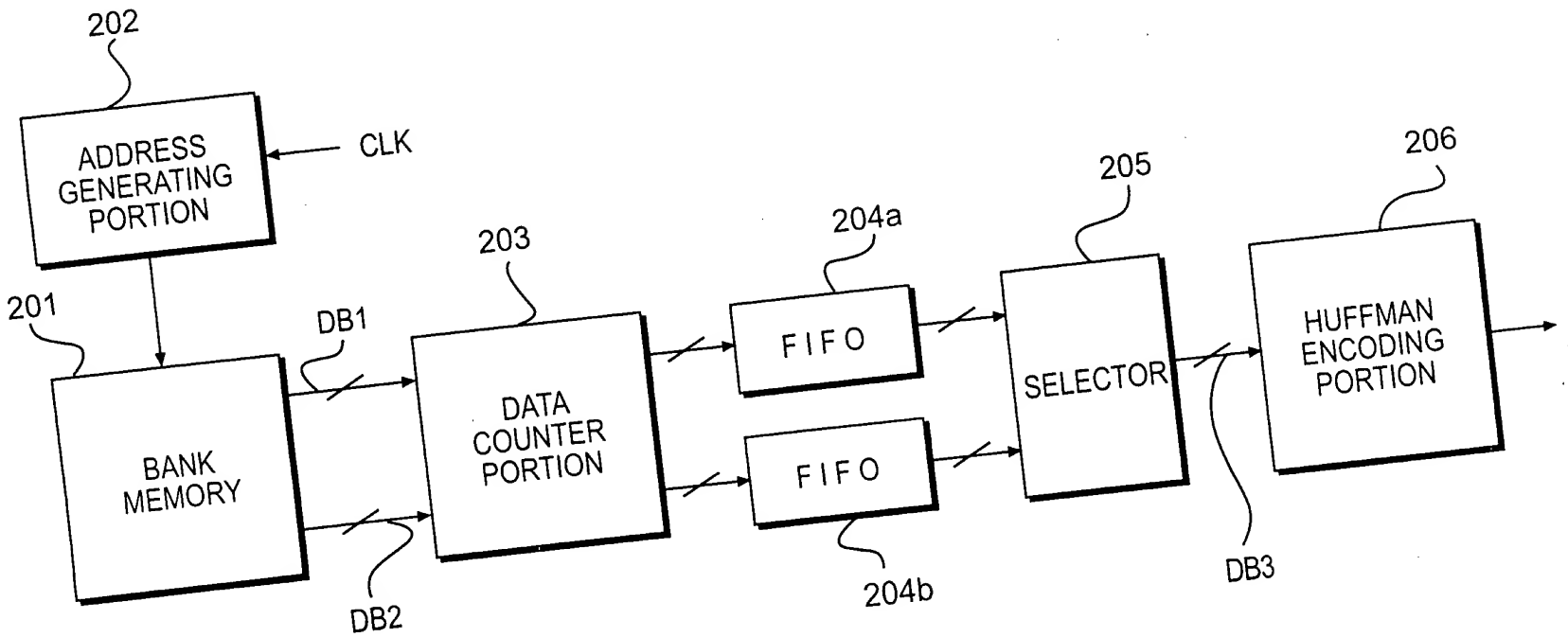

FIG. 13

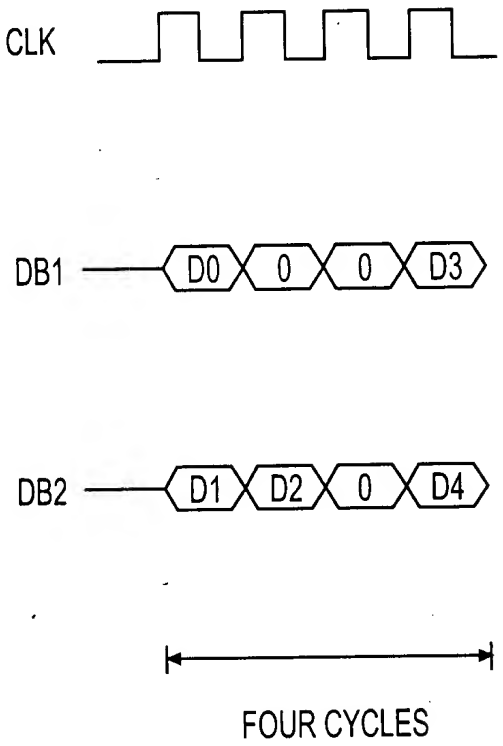

FIG. 14 (a)

CONTENTS OF FIFO 204a

RUN LENGTH		0	1	0
VALID COEFFICIENT		D4	D2	D0

CONTENTS OF FIFO 204b

RUN LENGTH			2	0
VALID COEFFICIENT			D3	D1

FIG. 14 (b)

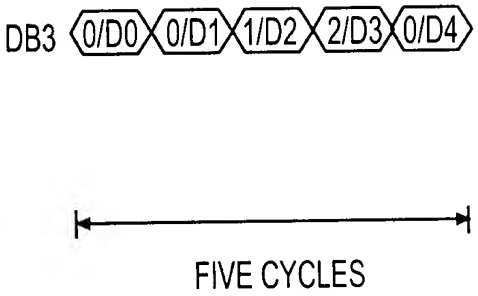

FIG. 14 (c)

09/622424

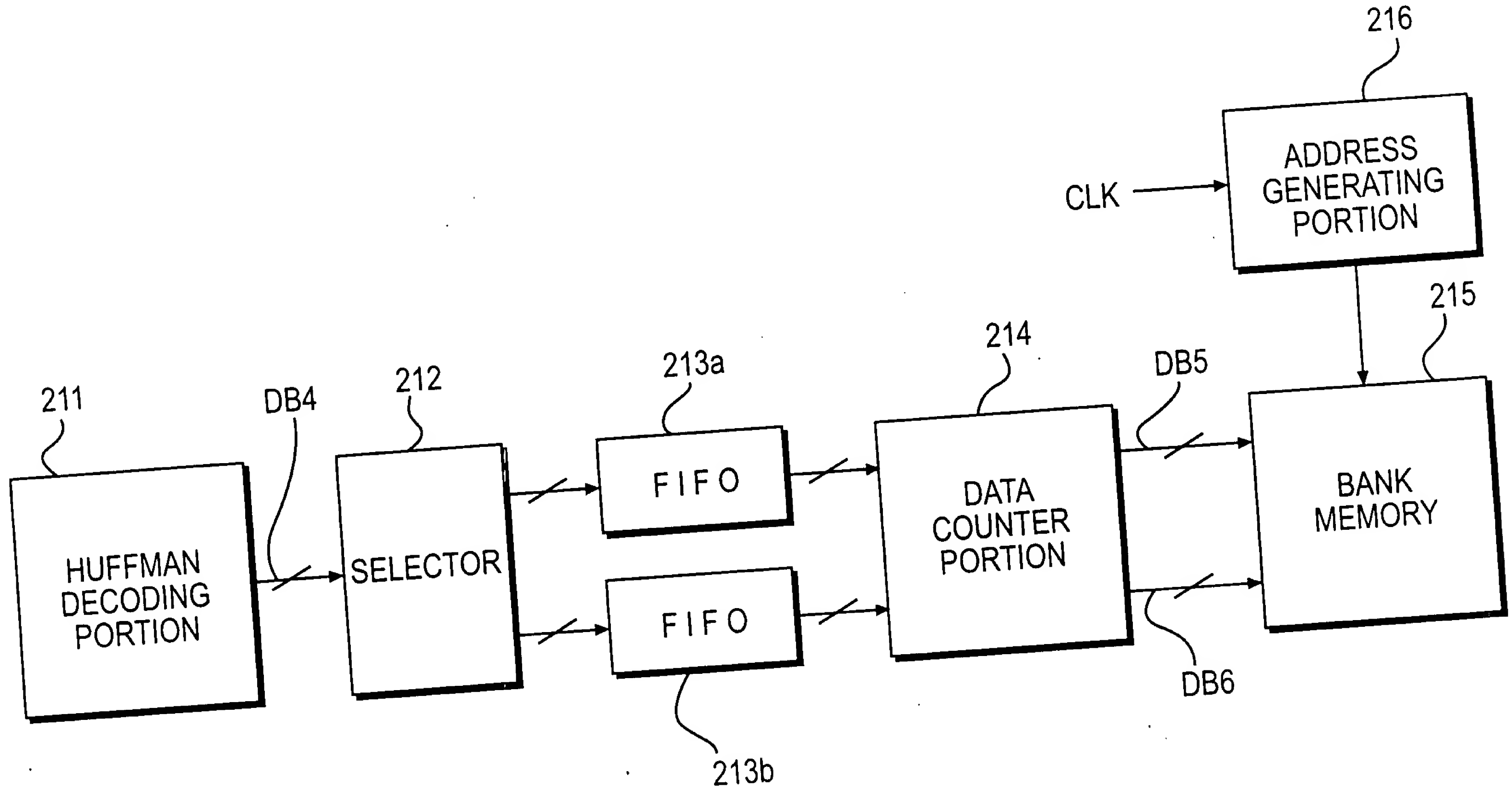

FIG. 15

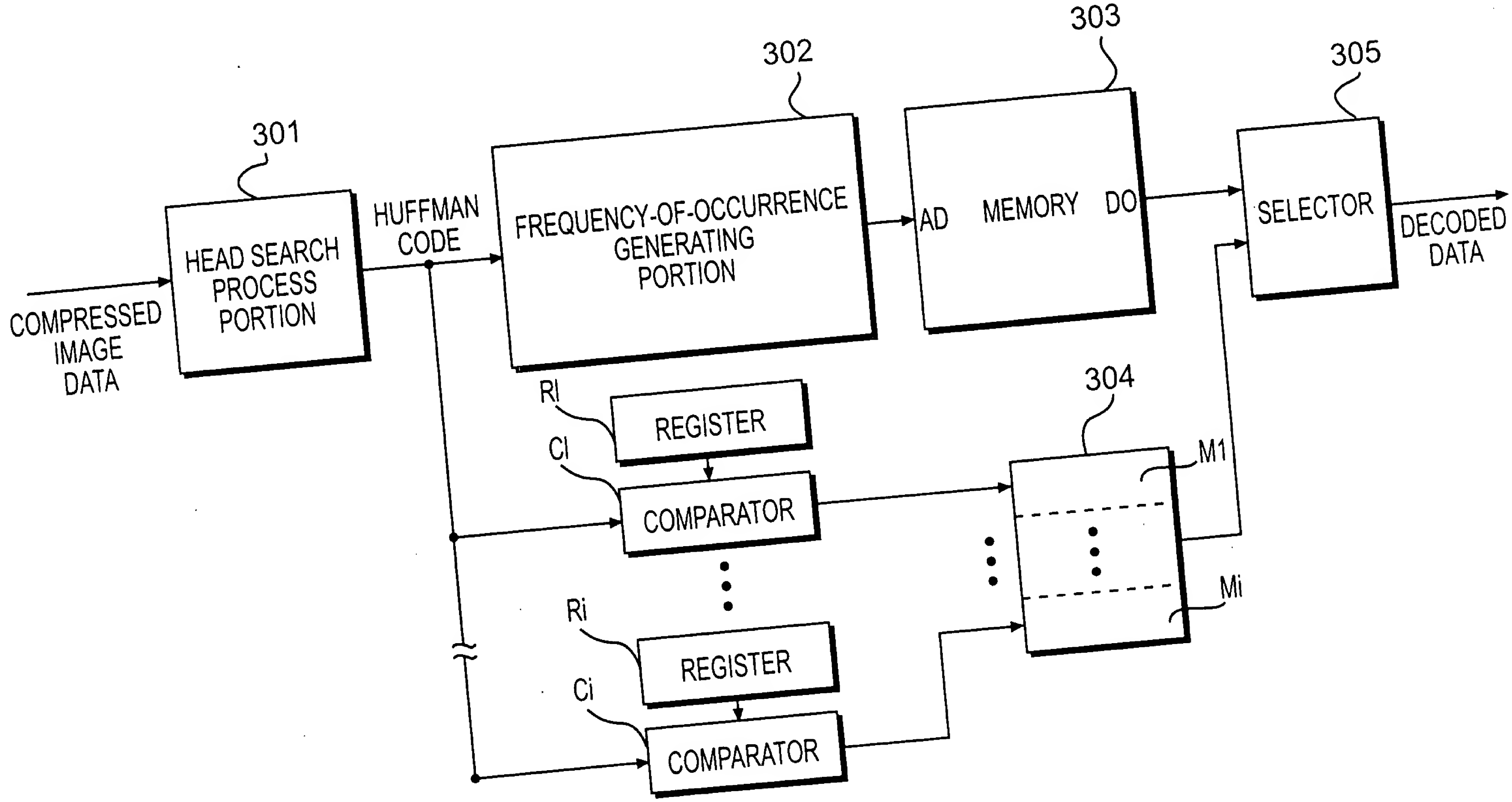
301
302
303
304
305
COMPRESSED IMAGE DATA
HEAD SEARCH PROCESS PORTION
HUFFMAN CODE
FREQUENCY-OF-OCCURRENCE GENERATING PORTION
AD
MEMORY
DO
SELECTOR
DECODED DATA
Rl
Cl
REGISTER
COMPARATOR
Ri
Ci
REGISTER
COMPARATOR
M1
Mi

FIG. 16

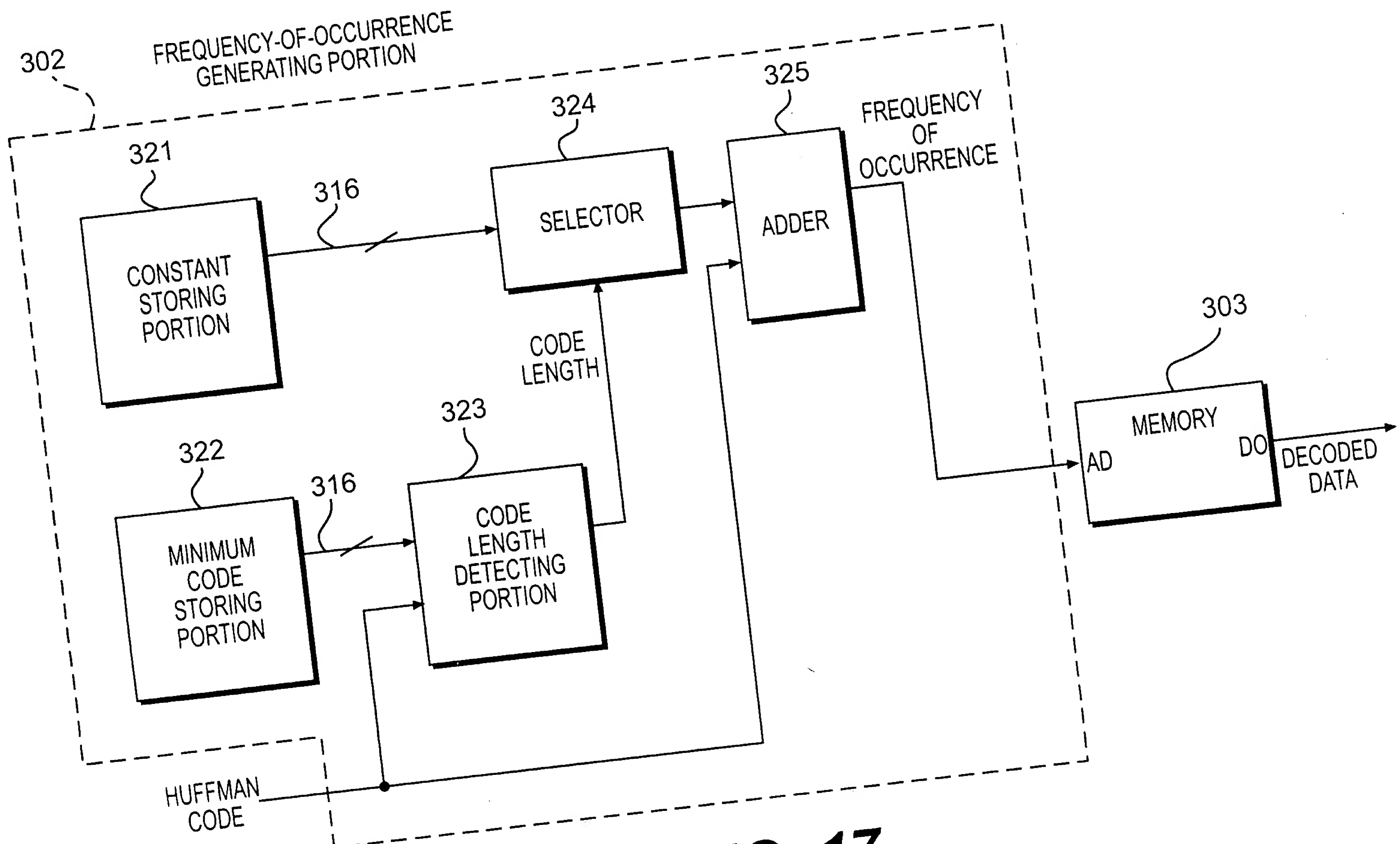
302
FREQUENCY-OF-OCCURRENCE GENERATING PORTION
321
CONSTANT STORING PORTION
316
324
SELECTOR
325
ADDER
FREQUENCY OF OCCURRENCE
322
MINIMUM CODE STORING PORTION
316
323
CODE LENGTH DETECTING PORTION
CODE LENGTH
HUFFMAN CODE
303
MEMORY
AD
DO
DECODED DATA

FIG. 17

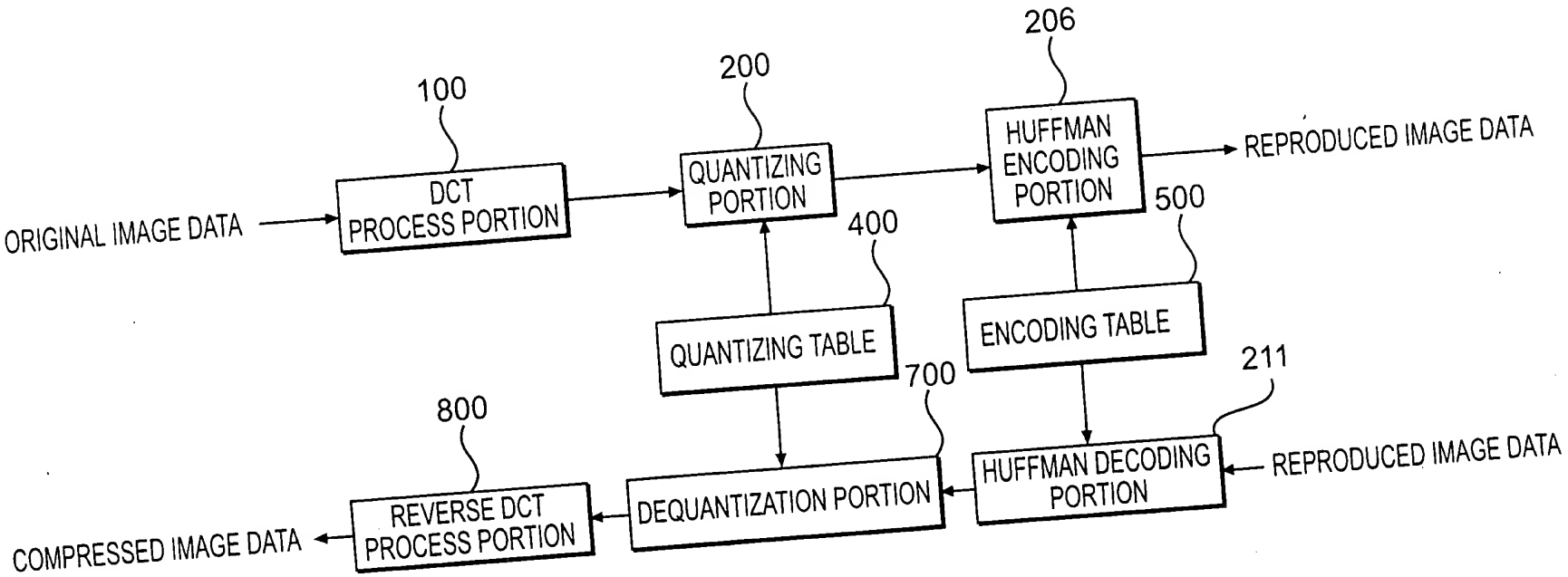

FIG. 18

FORMATION OF BLOCKS OF IMAGE DATA

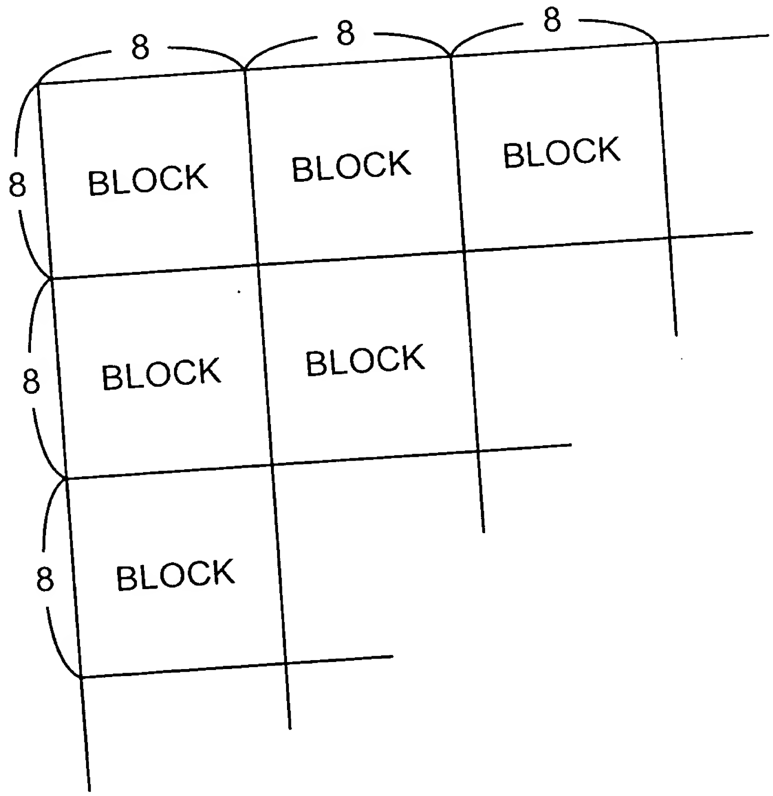

FIG. 19

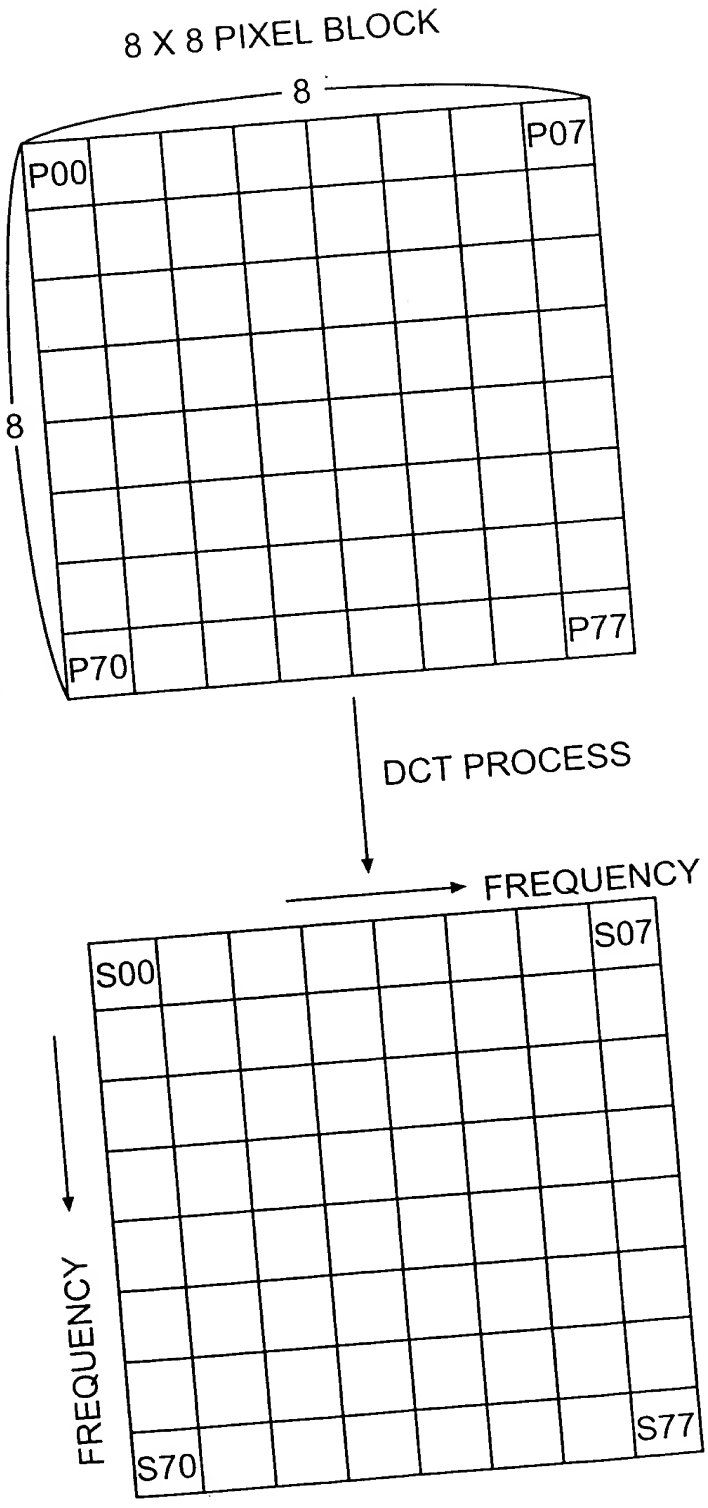
8 X 8 PIXEL BLOCK
8
8
P00
P07
P70
P77
DCT PROCESS
FREQUENCY
FREQUENCY
S00
S07
S70
S77

FIG. 20

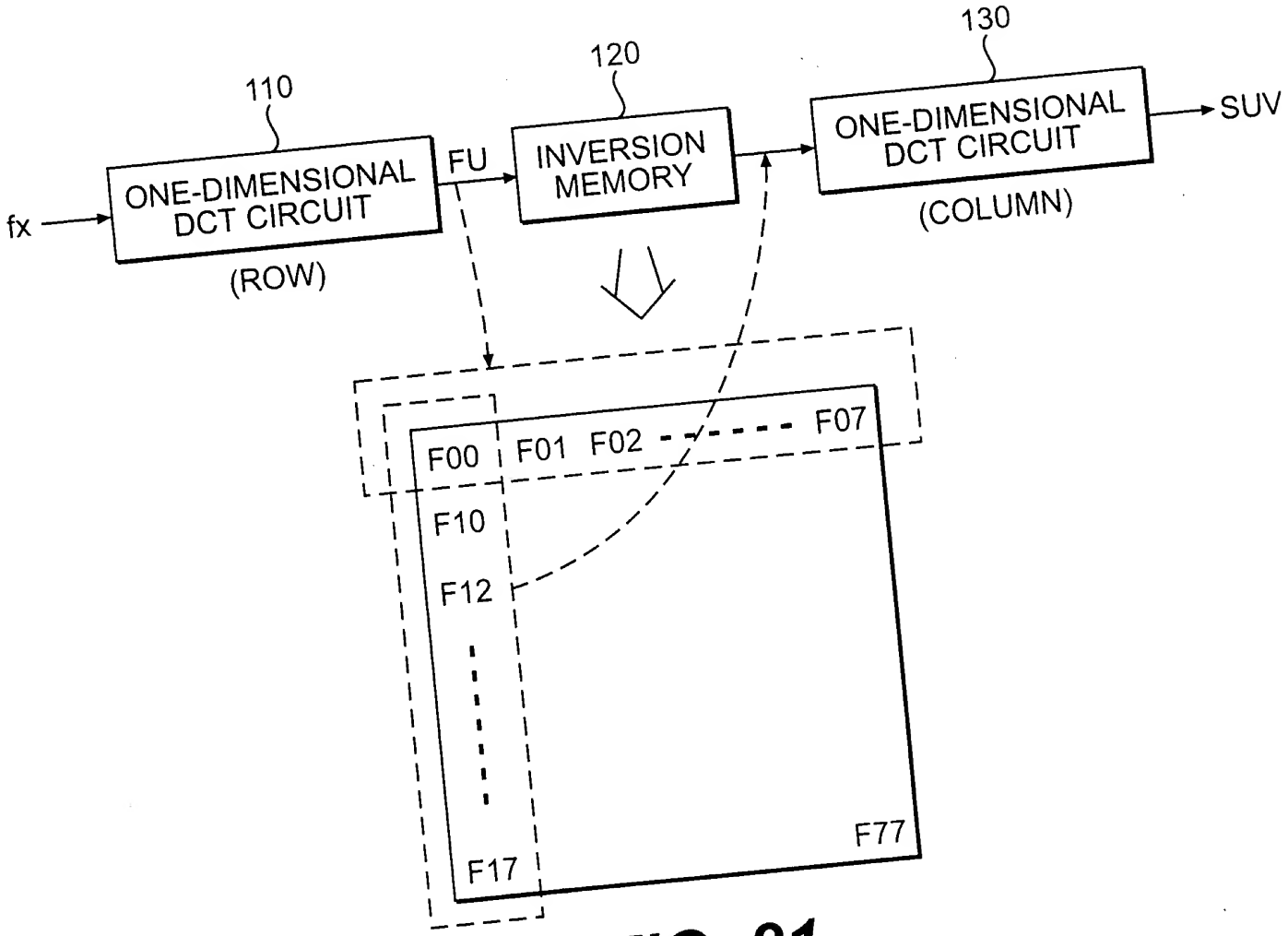

FIG. 21

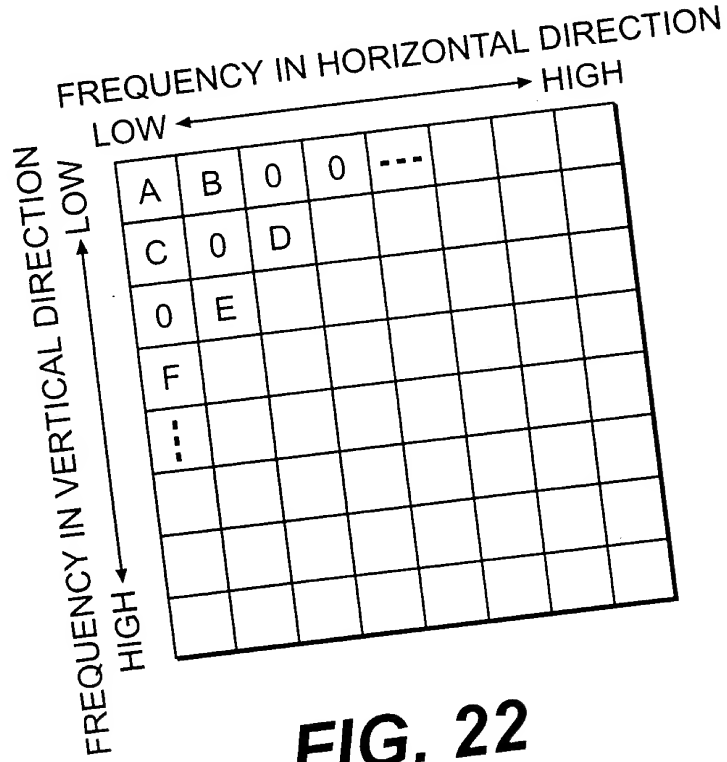

FIG. 22

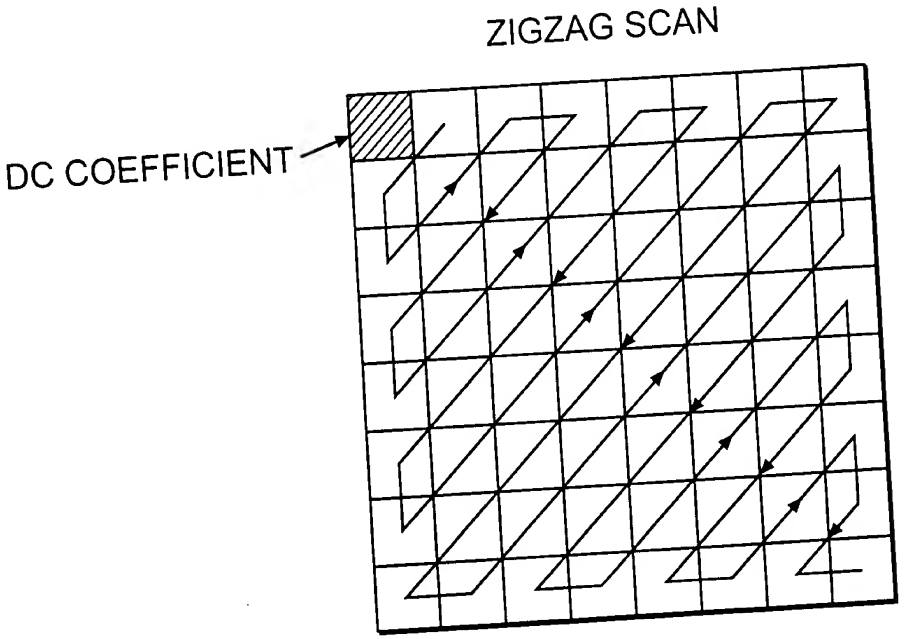

FIG. 23

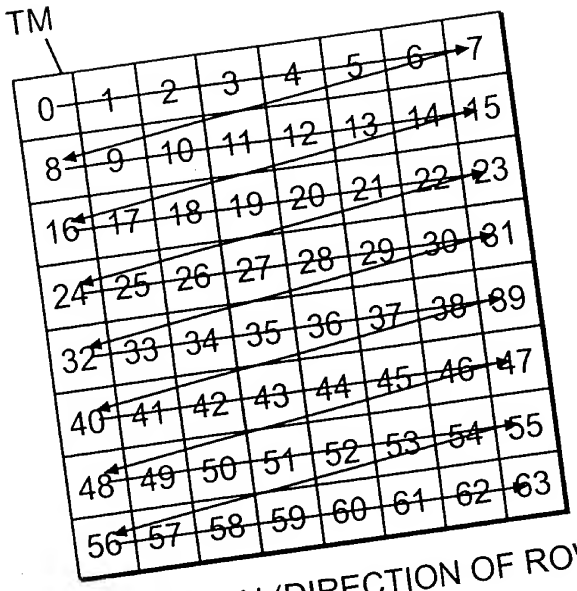

FIG. 24(a)

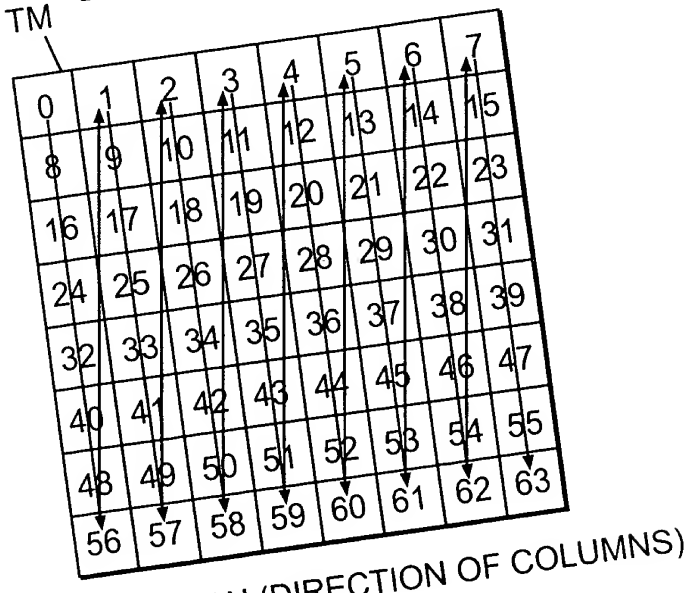

FIG. 24(b)

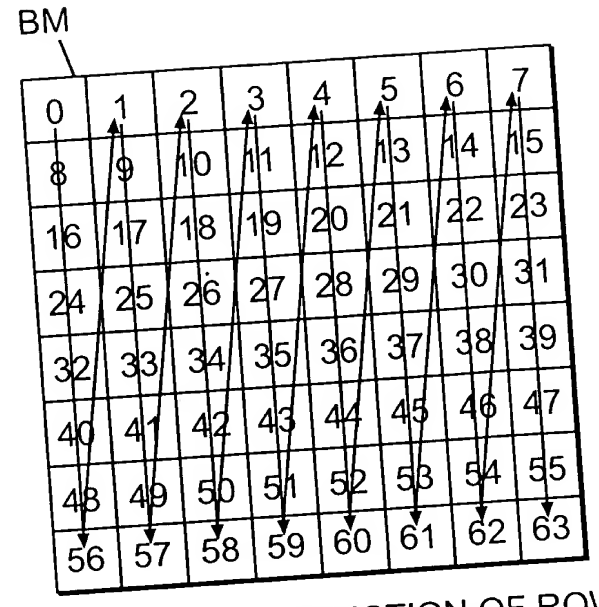

FIG. 25(a)

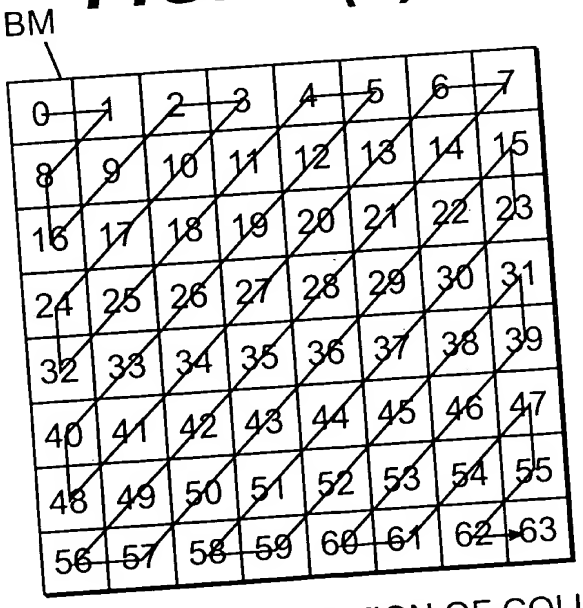

FIG. 25(b)

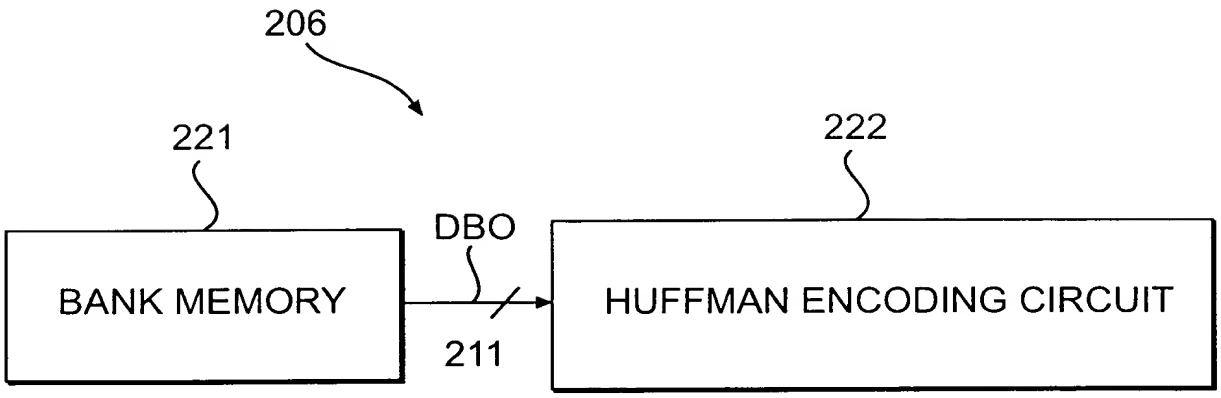

FIG. 26

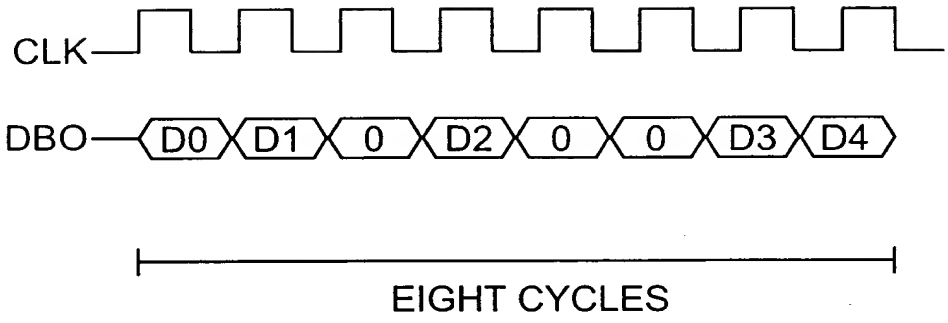

FIG. 27

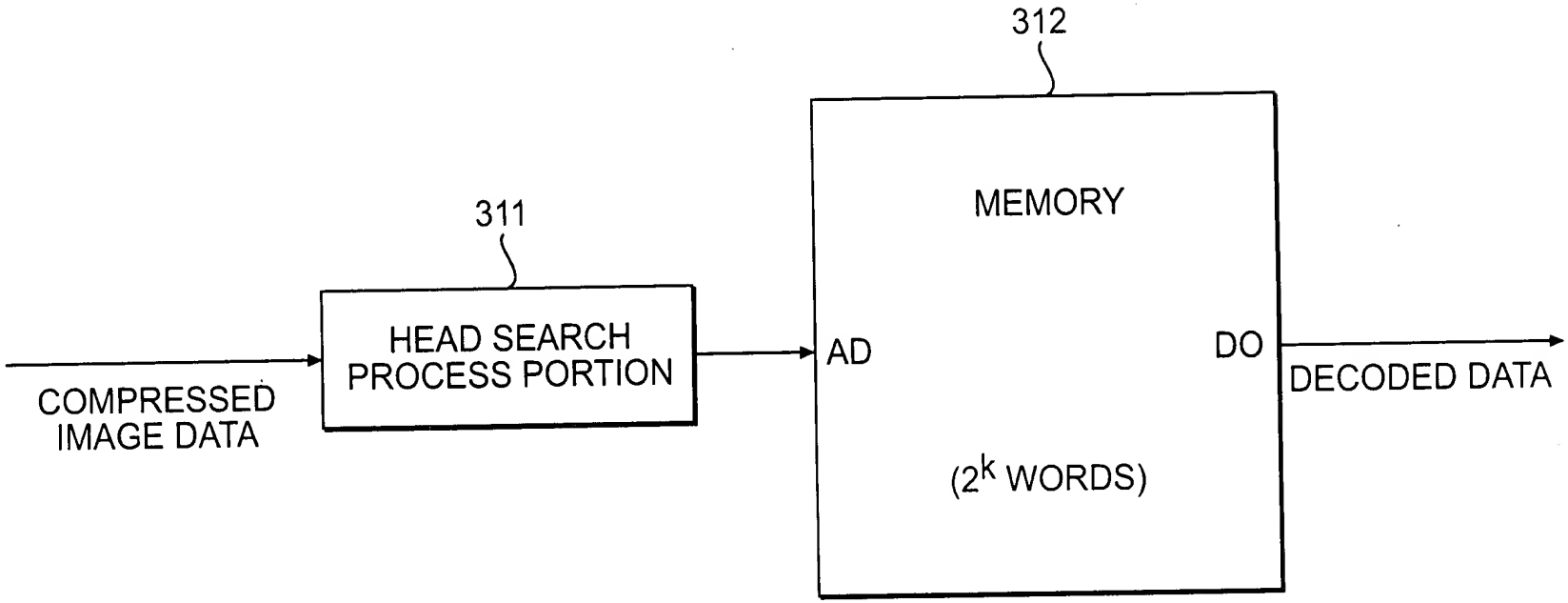

FIG. 28